SPACEX

July 26, 2021

BY ELECTRONIC FILING

Kerry E. Murray
Federal Communications Commission
45 L Street, N.E.
Washington, DC 20554

Re: *E210002, E202202, E202176, E202175, E202179, E202178, E202201, E210051*

Dear Ms. Murray:

This letter is in response to requests from the Federal Communication Commission to provide supplemental information and clarification with regard to earth station applications referenced above. Specifically, the Commission requested the following information:

1. Addition of county boundaries and distance/mileage scale to PFD contour plots
2. Clarification of power density ("clear sky power" value)
3. Confirmation that PFD contour will not cross any roads classified as "Other Freeways and Expressways or Other Principal Arterials," with details on related analysis and assumptions
4. Clarification of discrepancy in height above ground level
5. Explanation of changes in antenna sidelobe levels
6. Explanation of clutter assumptions
7. Technical details related to site shielding
8. Correction specific to Broadview, IL earth station
9. .kml files for PFD contours

Responses are as follows:

1155 F Street, NW Suite 475 Washington, DC 20004
phone 202.649.2700 fax 202.649.2701
spacex.com

1) Addition of county boundaries and distance/mileage scale to PFD contour plots

In accordance with 47 CFR § 25.136(a)(4)(ii), county boundaries and map legends with distance/mileage scale for measuring the relative size of the proposed PFD contour are included as Figures 1-5 in the appendix of this document for the following applications:

1. E210002 – Lockport, NY
2. E202202 – Marcell, MN
3. E202175 – Dumas, TX
4. E202201 – Hamshire, TX
5. E210051 – Broadview, IL

The county boundaries and map legends with distance/mileage scale were previously omitted from these applications. Updated PFD contours for Mandale, NC (E202178) and Wise, NC (E202179) will be submitted with their respective amendment filings. The PFD contour for Robbins, CA (E202176) is not required after the removal of 27.5 GHz - 28.35 GHz spectrum that overlaps with 5G.

2) Clarification of power density

To ensure compliance with 47 CFR § 25.136(a)(4)(ii) for the earth stations related to this supplemental pleading, SpaceX used worst-case input power density. SpaceX did not change maximum power during rain fade conditions, so clear-sky maximum power is the same as during rain fade for these earth station applications. These SpaceX license applications are conservative and currently account for worst-case antenna input power density of -19.7 dBW/MHz.

3) Confirmation that PFD contour will not cross any roads classified as "Other Freeways and Expressways or Other Principal Arterials," with details on related analysis and assumptions

In accordance with 47 CFR § 25.136(a)(4)(iii), SpaceX certifies that the PFD contours of the following earth stations will not cross any roads classified as "Other Freeways and Expressways or Other Principal Arterials:"

1) E210002 – Lockport, NY
2) E202202 – Marcell, MN
3) E202175 – Dumas, TX
4) E202179 – Wise, NC
5) E202178 – Mandale, NC
6) E202201 – Hamshire, TX
7) E210051 – Broadview, IL

To make this certification, SpaceX uses QGIS software to conduct an analysis of a comprehensive dataset of roadways obtained from the 2017 release of the HPMS[1] ARNOLD[2] dataset, belonging to the Federal Highway Administration of the Department of

[1] Highway Performance Monitoring System
[2] All Road Network of Linear Referenced Data

Transportation. To ensure compliance with 47 CFR § 25.136(a)(4)(iii), SpaceX analysis considers the following categories within the dataset: "Interstate," "Principal Arterial – Other Freeways and Expressways," and "Principal Arterial – Other". SpaceX uses QGIS and the comprehensive dataset of roadways to ensure that the PFD contour does cross any roads classified as "Other Freeways and Expressways or Other Principal Arterials." According to the website from which the dataset is obtained[3]: "[the dataset] derives and is collected from State DOT road data. ARNOLD consists of locations of all roads in the U.S." Therefore, relevant state roadways are considered in our analysis.

4) Clarification of discrepancy in height above ground level

In accordance with 47 CFR § 25.136(a)(4)(iv), the "height above ground level" in all earth station applications (1.7m), is the true centerline height of the antennas, and the value SpaceX uses to calculate the PFD contours. The "Antenna Centerline (AGL)" value previously used in Comsearch (0.91m) has been found to be a clerical error, and will be changed to 1.7m in all future Comsearch reports. Comsearch has informed us that it is not necessary to re-do coordination or update Comsearch reports based on this change, because the change is not expected to impact any relevant analyses. Related email correspondence with Comsearch has been submitted as a separate attachment along with this supplement pleading.

5) Explanation of changes in antenna sidelobe levels

The antenna sidelobe level toward the horizon used in several previous applications is -1 dBi. More recent applications (listed below) feature a -8 dBi antenna sidelobe level towards the horizon. This difference is due to improvements in SpaceX gateway antenna design over time – newer antennas have a lower antenna sidelobe level toward the horizon. See appendix Figure 6 for detail on antenna sidelobe measurements and related methodology.

6) Explanation of clutter assumptions

Detail on clutter assumptions for the gateways referenced in this supplemental pleading can be found below.

<u>Lockport, NY (E210002)</u>

- The "irregularly spaced sparse trees" and "sparse houses" clutter categories of the ITU P.452 model were used for this application. According to the ITU P.452 model, this translates to clutter assumptions of 4 meters nominal height and 0.1 kilometers nominal distance.
- The "irregularly spaced sparse trees" and "sparse houses" clutter categories were determined to be most appropriate based on measurements and analysis via Google Earth software and in-person site survey. Figures 7a-7c provide a visual of the site environment, obtained during in-person site surveys.

[3] Source: https://www.bts.gov/geography/geospatial-portal/NTAD-direct-download

Marcell, MN (E202202)

- Clutter assumptions of 4 meters height and 0.4 kilometers distance were used in the PFD contour analysis for this earth station. These assumptions were determined to be most appropriate based on measurements and analysis via Google Earth software and in-person site survey. Figure 8 provide a visual of the site environment, obtained during in-person site surveys.
- Analysis for this earth station was done before SpaceX began using the ITU P.452 clutter categories for clutter assumptions, and therefore does not align precisely to an existing ITU P.452 clutter category.
- The clutter assumptions for this earth station (4 meters height; 0.4 kilometers distance) align most closely to the ITU P.452 clutter category of "irregularly spaced sparse trees," which represents clutter assumptions of 4 meters height and 0.1 kilometers distance. A review of the site survey photos (Figure 8) and Google Earth satellite view confirm that "irregularly spaced sparse trees" is an appropriate categorization.
- The ITU P.452 clutter category of "irregularly spaced sparse trees" is the most conservative category available, and SpaceX's clutter assumptions for this gateway are more conservative than the assumptions associated with this category. Therefore, SpaceX believes the current clutter assumptions to be appropriate for PFD contour analysis and for demonstrating compliance with relevant regulations.

Robbins, CA (E202176)

- Amendment SES-AMD-20210615-00961 was filed on June 14th, 2021 in order to remove shared spectrum (27.5-28.35 GHz) from this application. As a result, PFD contour analysis and related clutter assumptions are no longer required.

Dumas, TX (E202175)

- No clutter was assumed in the PFD contour analysis for this earth station.

Wise, NC (E202179)

- Updated clutter assumptions for this earth station will be submitted with its respective amendment filing or supplemental pleading.

Mandale, NC (E202178)

- Updated clutter assumptions for this earth station will be submitted with its respective amendment filing or supplemental pleading.

Hamshire, TX (E202201)

- Clutter assumptions of 4 meters height and 0.4 kilometers distance were used in the PFD contour analysis for this earth station. These assumptions were determined to be most appropriate based on measurements and analysis via Google Earth software and in-person site survey. Figure 9 provide a visual of the site environment, obtained during in-person site surveys.

- Analysis for this earth station was done before SpaceX began using the ITU P.452 clutter categories for clutter assumptions, and therefore does not align precisely to an existing ITU P.452 clutter category.
- The clutter assumptions for this earth station (4 meters height; 0.4 kilometers distance) align most closely to the ITU P.452 clutter category of "irregularly spaced sparse trees" and "sparse houses," which represent clutter assumptions of 4 meters height and 0.1 kilometers distance. A review of the site survey photos (Figure 9) and Google Earth satellite view confirm that "irregularly spaced sparse trees" and "sparse houses" are appropriate categorizations.
- The ITU P.452 clutter categories of "irregularly spaced sparse trees" and "sparse houses" are the most conservative categories available, and SpaceX's clutter assumptions for this gateway are more conservative than the assumptions associated with these categories. Therefore, SpaceX believes the current clutter assumptions to be appropriate for PFD contour analysis and for demonstrating compliance with relevant regulations.

Broadview, IL (E210051)

- The "Suburban" clutter category of the ITU P.452 model was used for this application. According to the ITU P.452 model, this translates to clutter assumptions of 9 meters nominal height and 0.025 kilometers nominal distance.
- The "Suburban" clutter category was determined to be most appropriate based on analysis and measurements via Google Earth software and in-person site survey. Figures 10a-10b provide a visual of the site environment and additional detail, obtained during in-person site surveys.

7) Technical details related to site shielding

All SpaceX gateway antenna sites in the US are surrounded with a solid metal panel fence, which is 8 feet in height and is set 11 feet and 6 inches from the centerline of the outermost antennas. Each earth station is analyzed independently to determine the shielding value required to comply with 47 CFR § 25.136(a)(4)(iii), based on PFD contours. The independent nature of the analysis explains the variation in shielding values between applications. SpaceX installs shielding at all sites with effectiveness equal to or greater than the value required to remain in compliance with 47 CFR § 25.136(a)(4)(iii).

8) Correction specific to Broadview, IL earth station

The license narrative submitted along with application for Broadview, IL (Callsign E210051) incorrectly justified this earth station's compliance with 25.136(a)(4)(ii) population limits. The correct justification is as follows: "Section 25.136(a)(4)(ii) provides that an earth station operator need not provide interference protection to future UMFUS systems if, in a UMFUS license area with a population greater than 450,000 people, no more than 0.1% of the population in the UMFUS license area will be within the earth station's PFD contour that is equal to or exceeds -77.6 dBm/m2/MHz. The Broadview Gateway is located in Cook County, which has a population of approximately 5,150,233 people. 0.1% of the population would be equivalent to 5,150 people. As demonstrated below [in Figure 5b], the Broadview Gateway's PFD contour contains fewer than 2,911 people."

9) .kml files for PFD contours

The Federal Communications Commission has requested that .kml files representing PFD contours and census block boundaries be submitted for the earth station applications listed below, as well as all earth station applications in the future. .kml files for files listed below have been submitted in a .zip file along with this supplement pleading. .kml files for Wise, NC (E202179) and Mandale, NC (E202178) will be submitted with their amendments.

1) E210002 - Lockport, NY
2) E202202 - Marcell, MN
3) E202175 - Dumas, TX
4) E202201- Hamshire, TX
5) E210051 - Broadview, IL

Sincerely,

David Liptsyn

David Liptsyn
Gateway Site Acquisition Analyst
SpaceX

Appendix

Figure 1a: PFD Contour with county boundaries and distance/mileage scale for Lockport, NY (Callsign E210002)

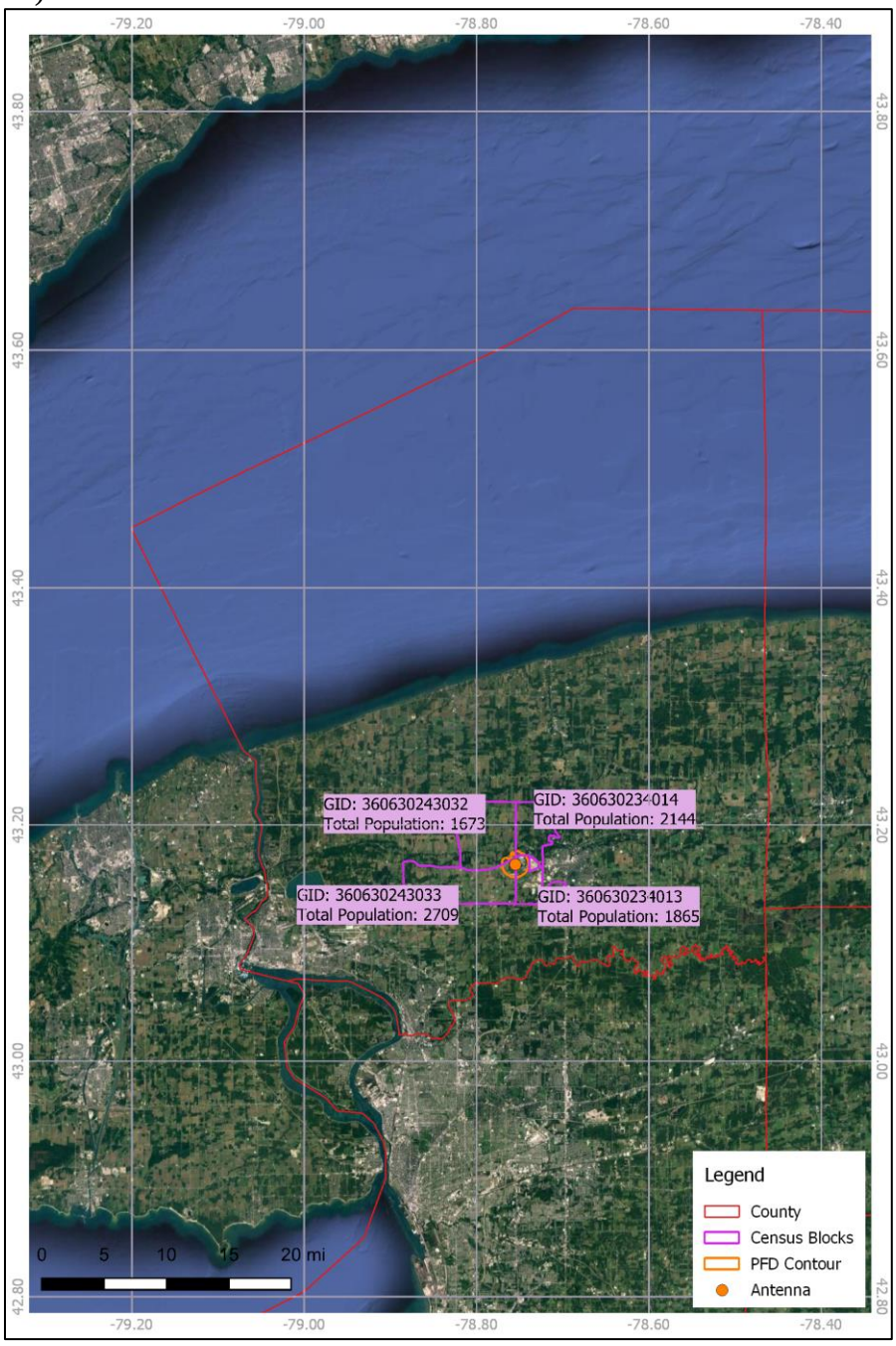
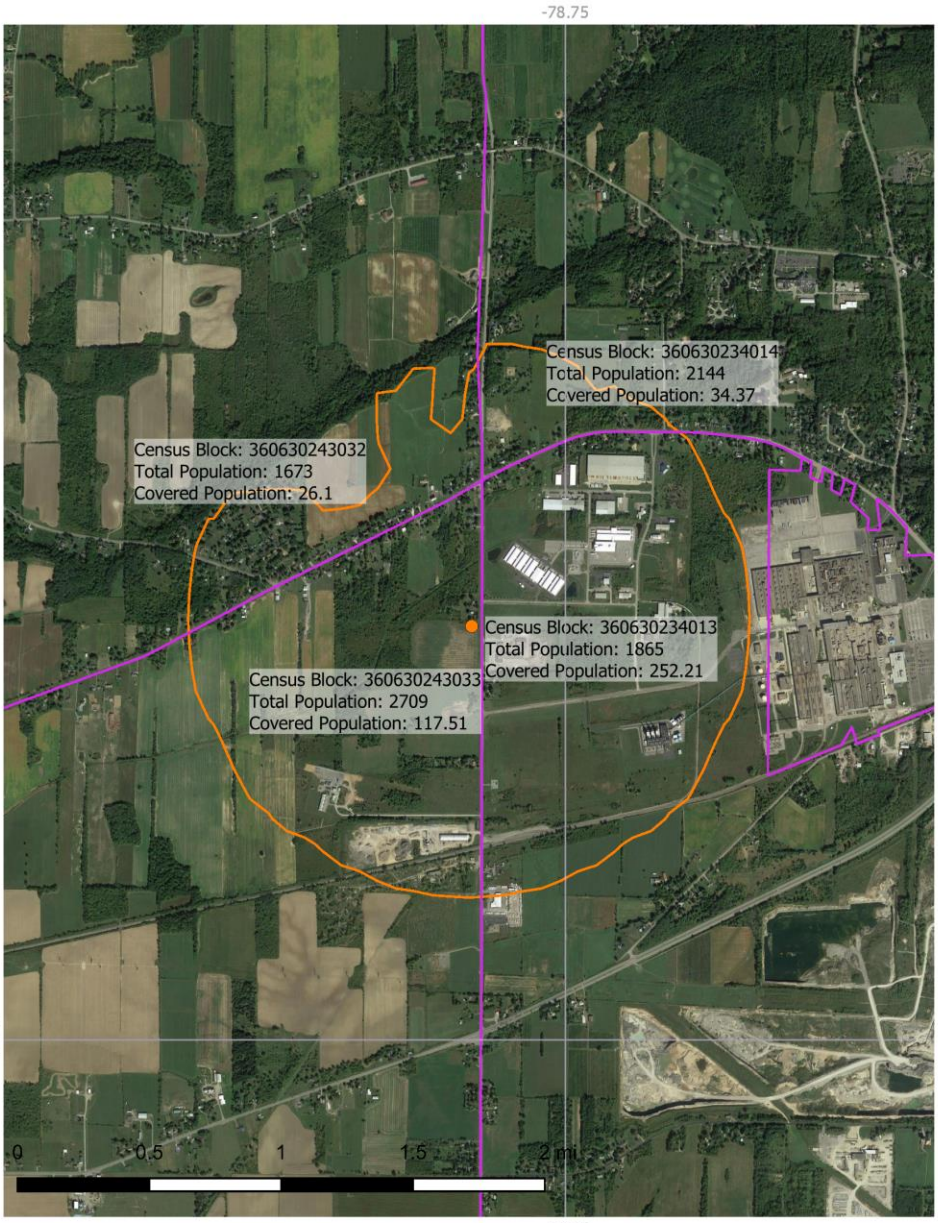


Figure 1b: PFD Contour with distance/mileage scale for Lockport, NY (Callsign E210002)



Census Block ID	Total Block Population	Covered Area	Covered Block Population
360630234014	2144	1.60%	34.37
360630234013	1865	13.52%	252.21
360630243032	1673	1.56%	26.10
360630243033	2709	4.34%	117.51

Total Covered Population = 430.18

Legend
- Census Blocks
- PFD Contour
- Antenna

Figure 1c: PFD Contour with distance/mileage scale for Lockport, NY (Callsign E210002)

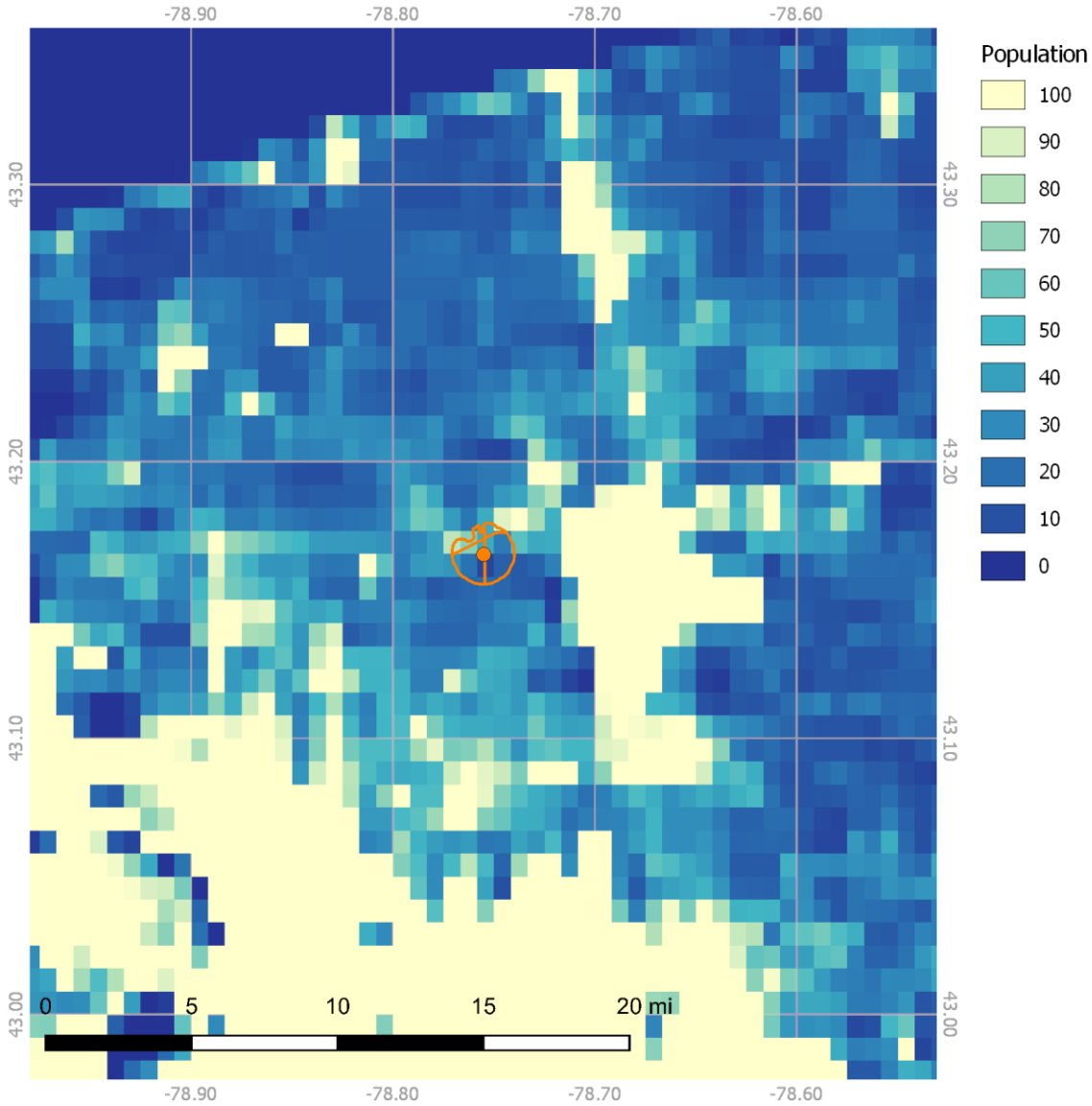


Figure 2a: PFD Contour with county boundaries and distance/mileage scale for Marcell, MN (Callsign E202202)

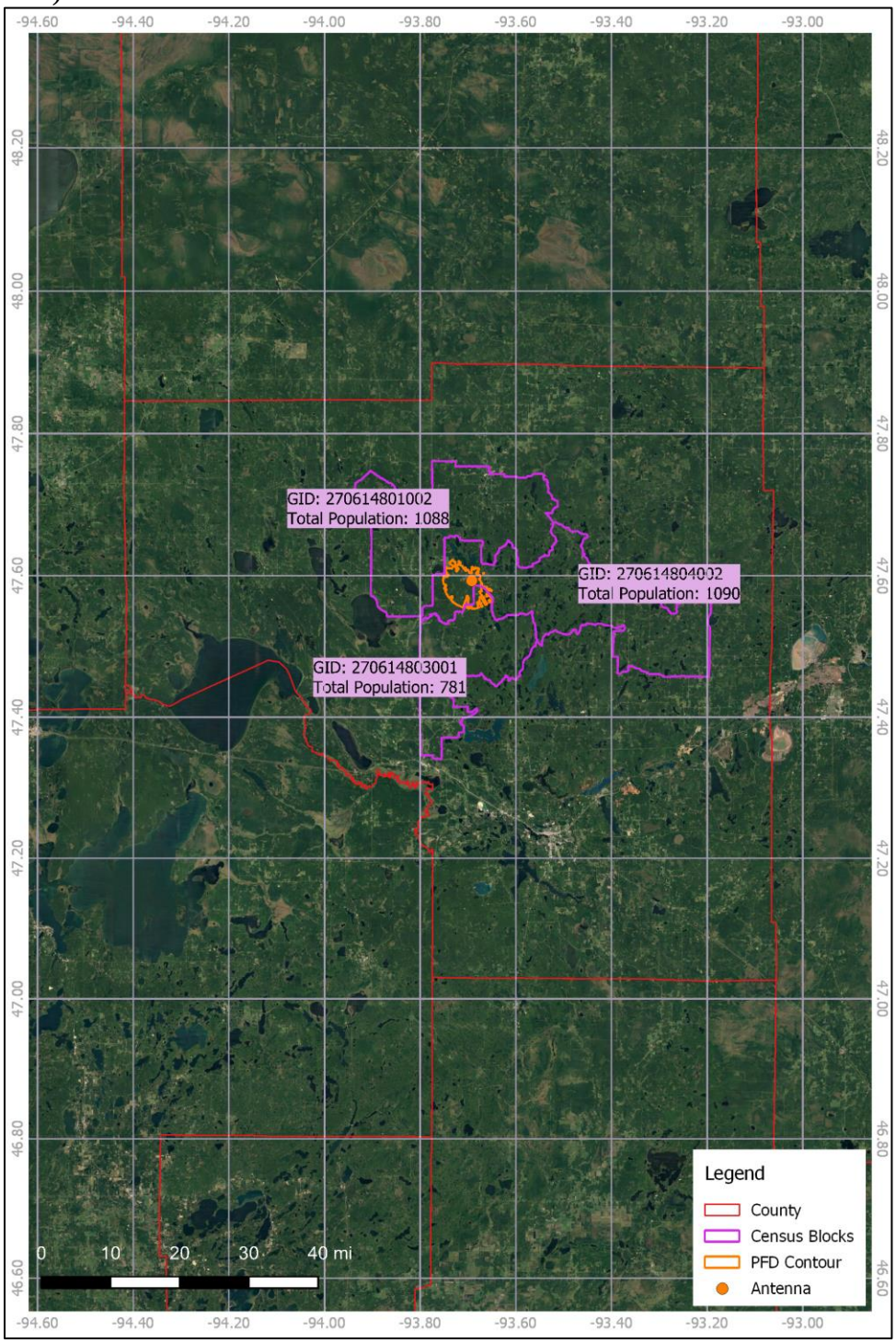
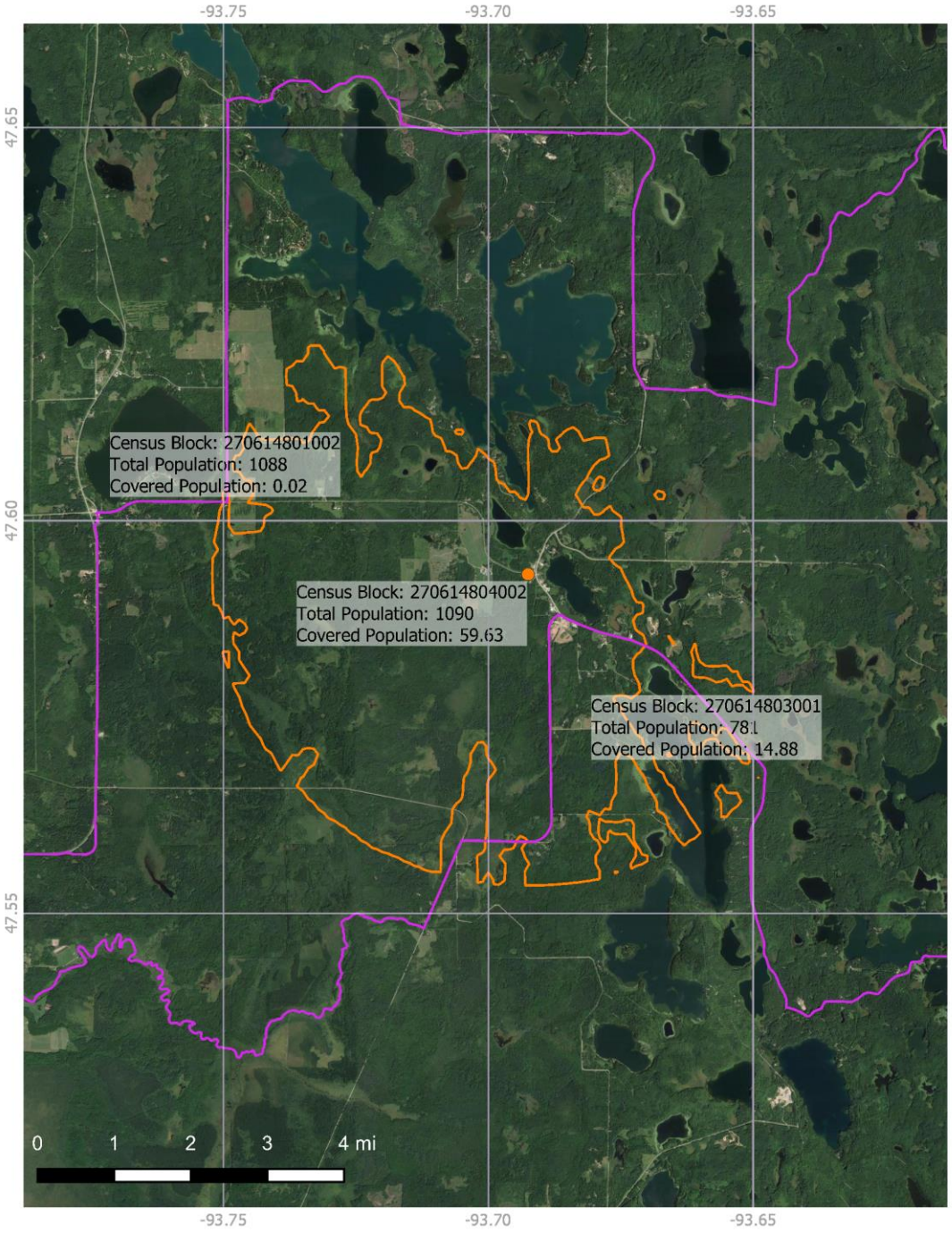


Figure 2b: PFD Contour with distance/mileage scale for Marcell, MN (Callsign E202202)



Census Block ID	Total Block Population	Covered Area	Covered Block Population
270614803001	781	1.91%	14.88
270614804002	1090	5.47%	59.63
270614801002	1088	0.00%	0.02

Legend
- Census Blocks
- PFD Contour
- Antenna

Total Covered Population = 74.54

Figure 2c: PFD Contour with distance/mileage scale for Marcell, MN (Callsign E202202)

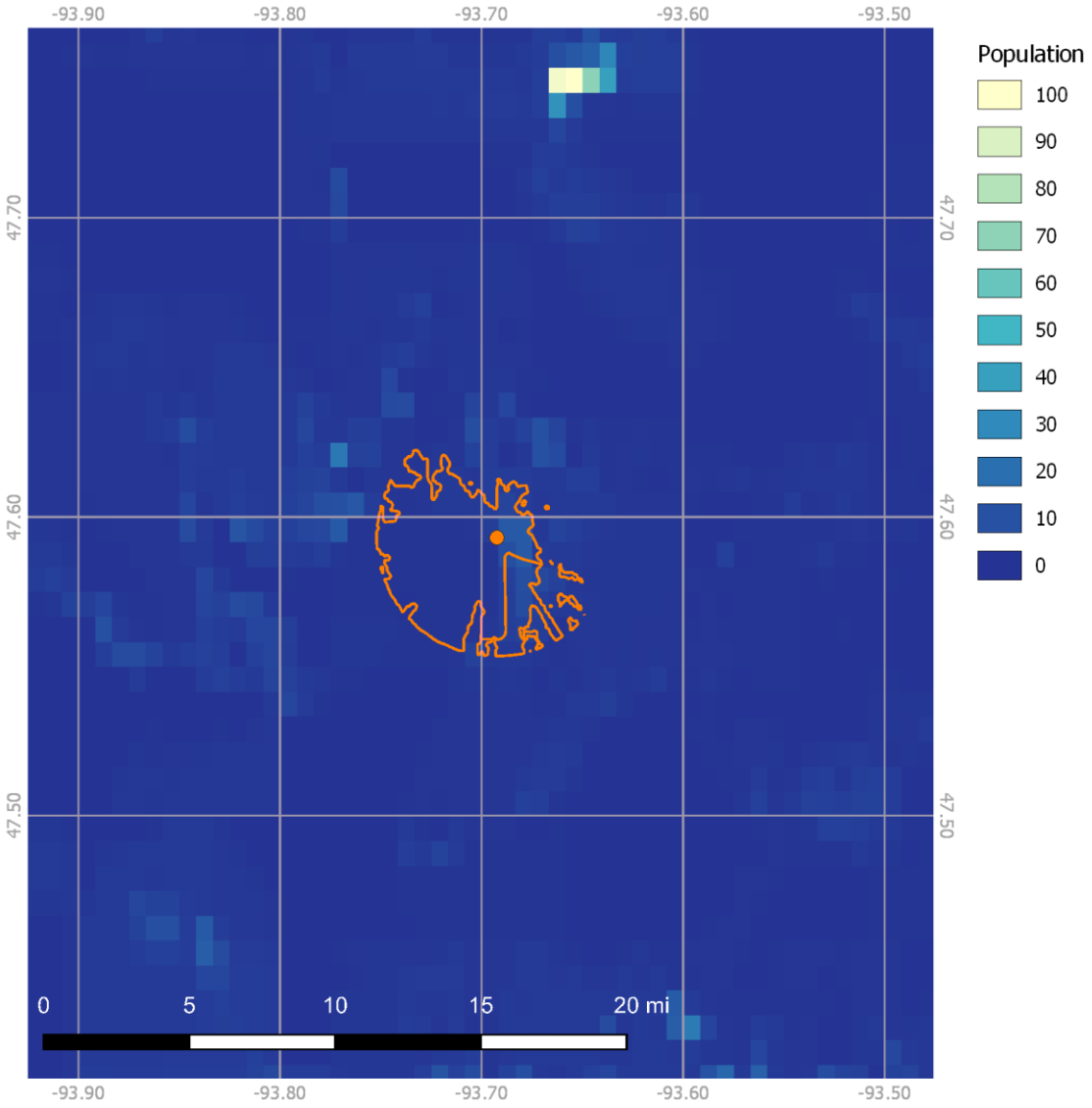


Figure 3a: PFD Contour with county boundaries and map legend for Dumas, TX (Callsign E202175)

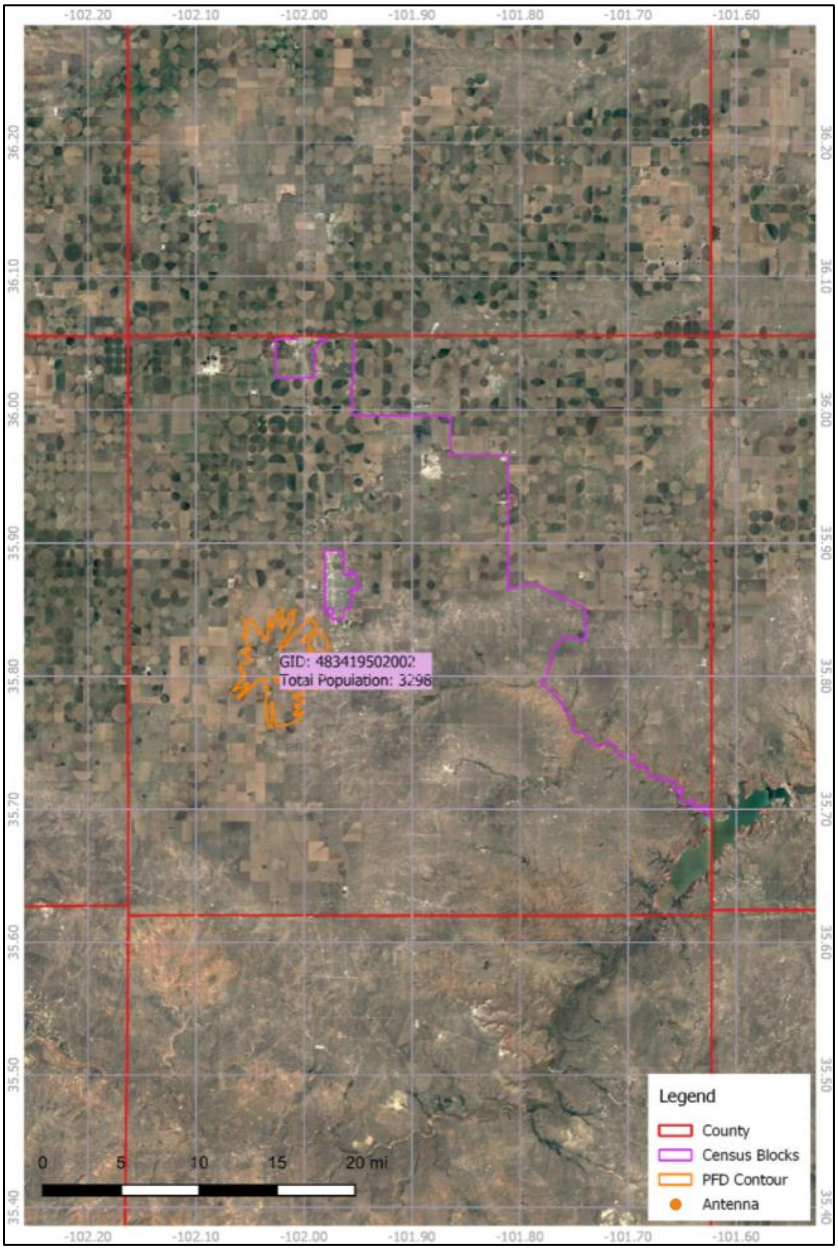
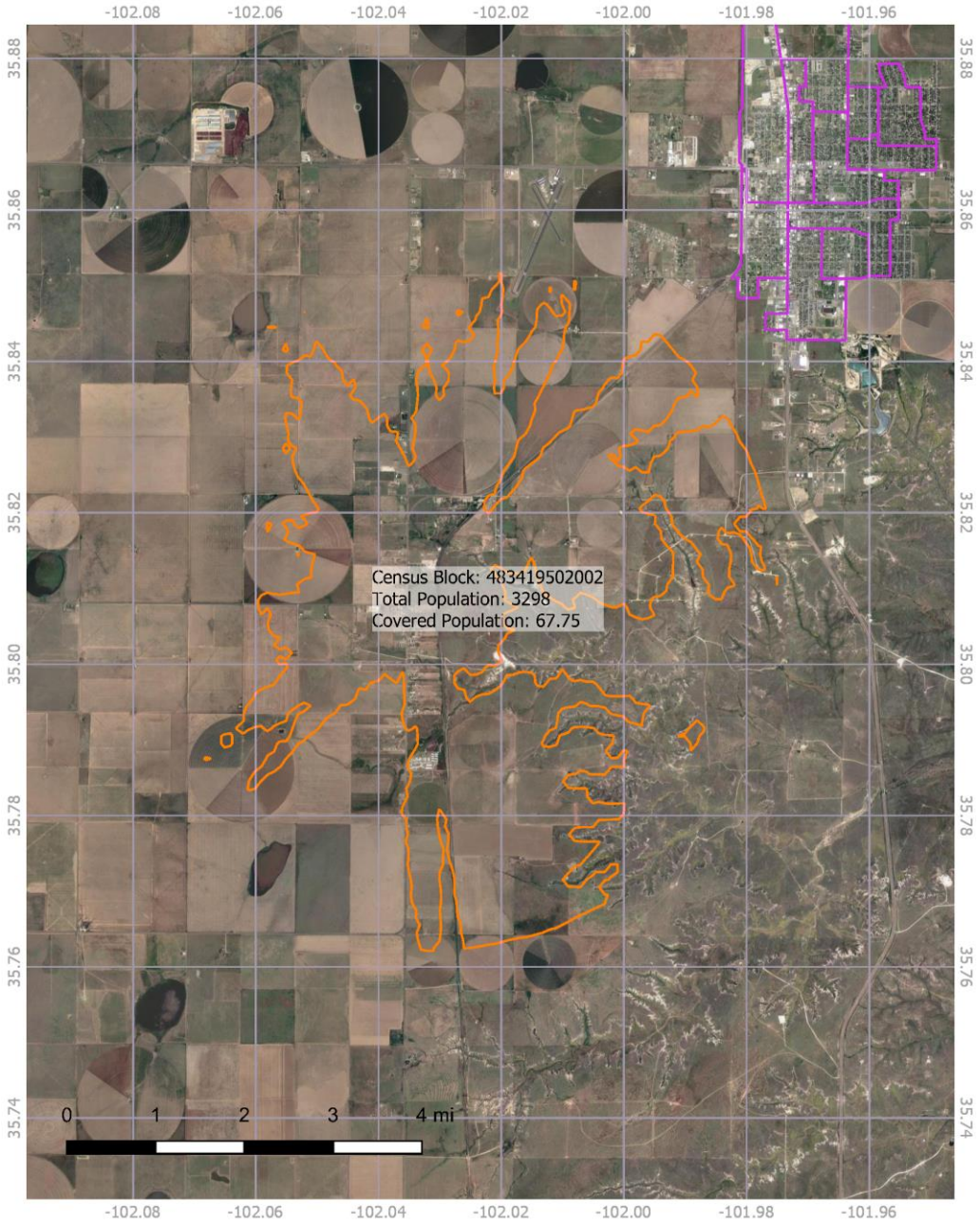


Figure 3b: PFD Contour with distance/mileage scale for Dumas, TX (Callsign E202175)



Census Block ID	Total Block Population	Covered Area	Covered Block Population
483419502002	3298	2.05%	67.75

Legend
- Census Blocks
- PFD Contour
- Antenna

Total Covered Population = 67.75

Figure 3c: PFD Contour with distance/mileage scale for Dumas, TX (Callsign E202175)

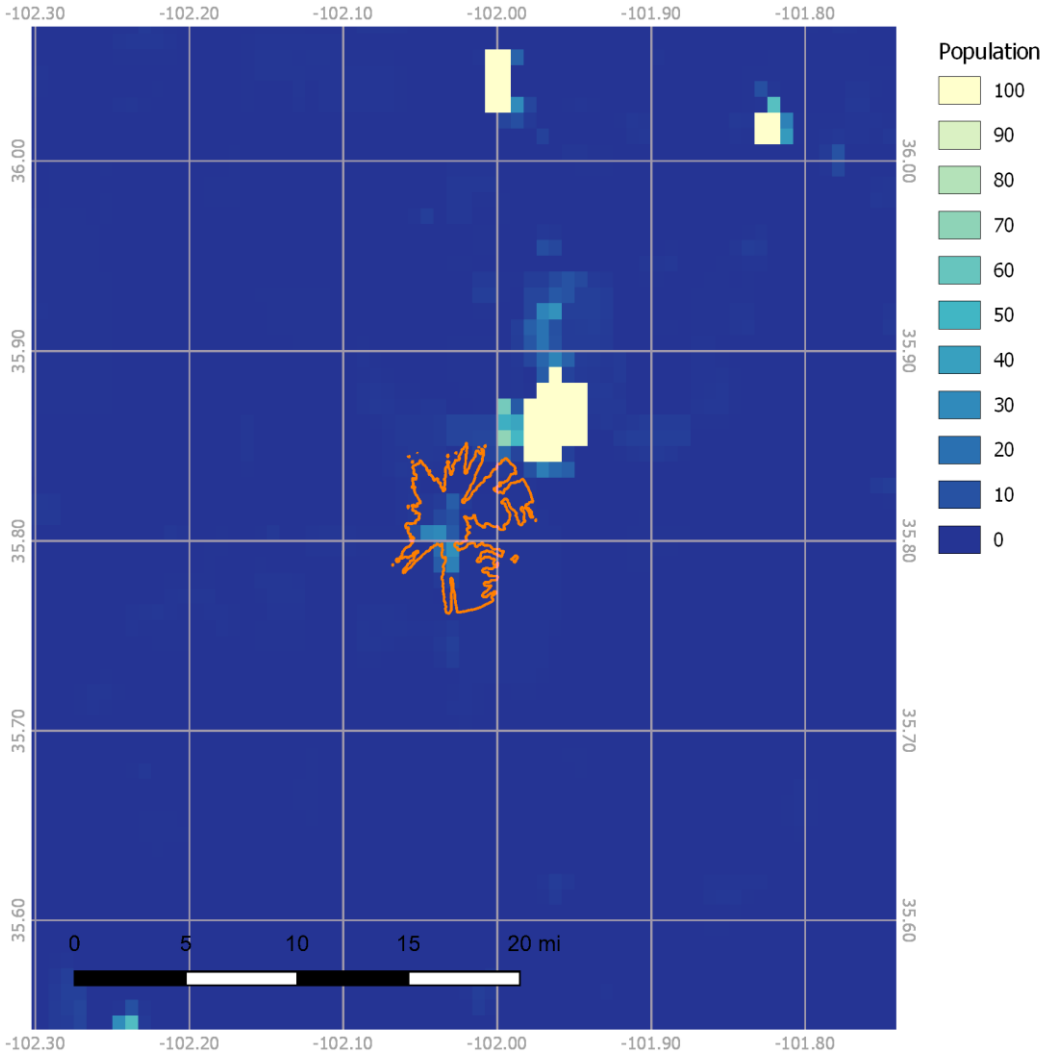


Figure 4a: PFD Contour with county boundaries and map legend for Hamshire, TX (Callsign E202201)

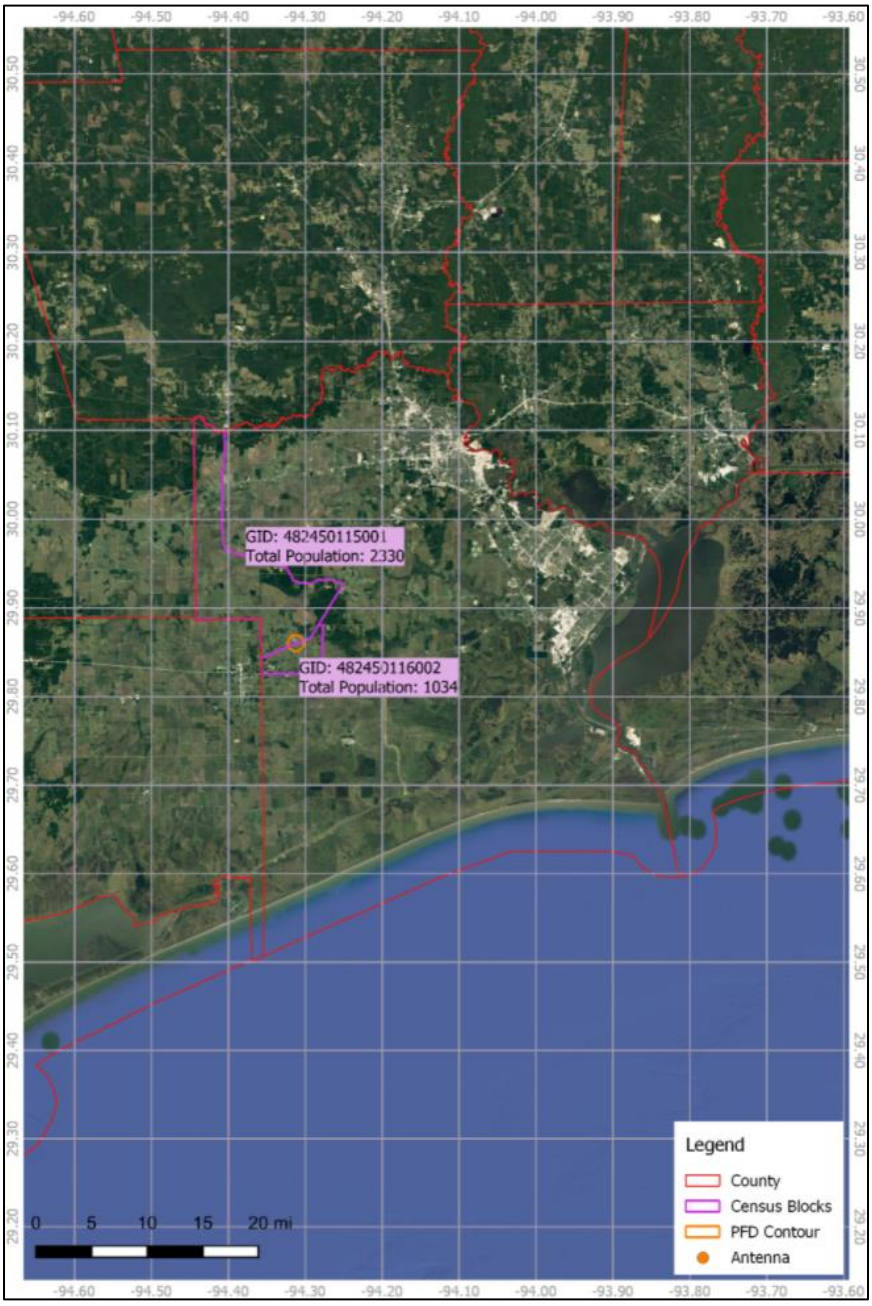
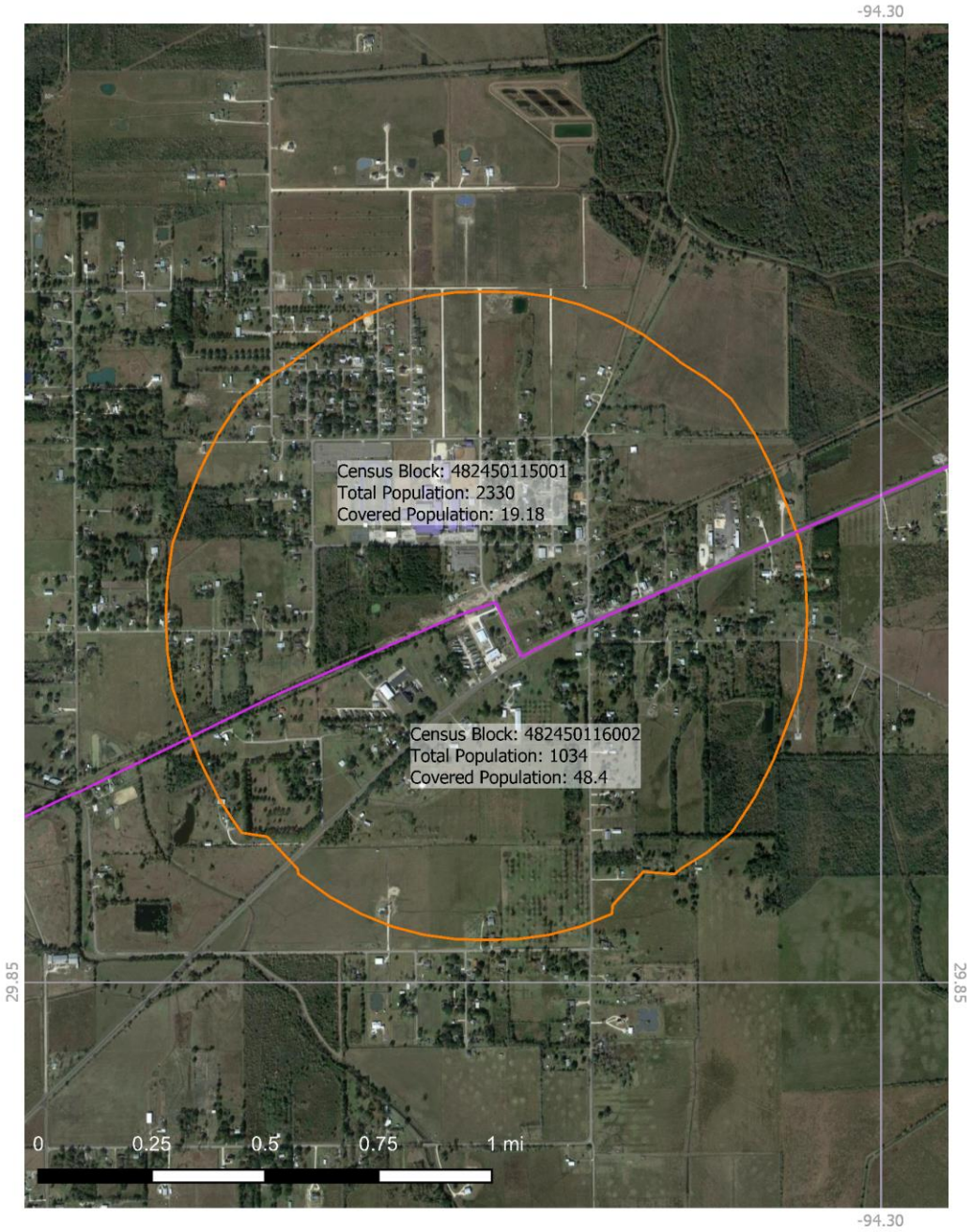


Figure 4b: PFD Contour with distance/mileage scale for Hamshire, TX (Callsign E202201)



Census Block ID	Total Block Population	Covered Area	Covered Block Population
482450116002	1034	4.68%	48.40
482450115001	2330	0.82%	19.18

Legend
- Census Blocks
- PFD Contour
- Antenna

Total Covered Population = 67.58

Figure 4c: PFD Contour with distance/mileage scale for Hamshire, TX (Callsign E202201)

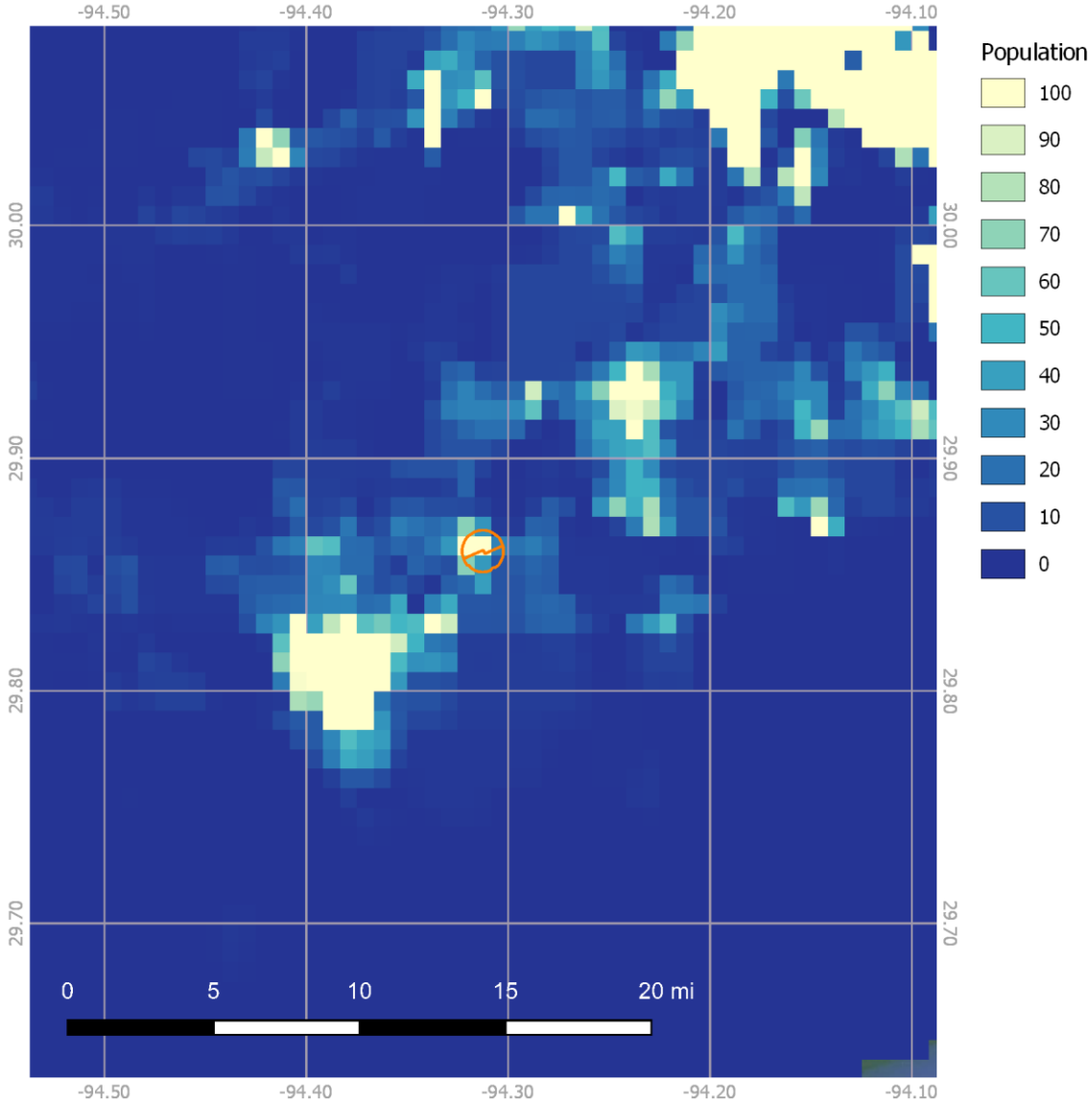


Figure 5a: PFD Contour with county boundaries and map legend for Broadview, IL (Callsign E210051)

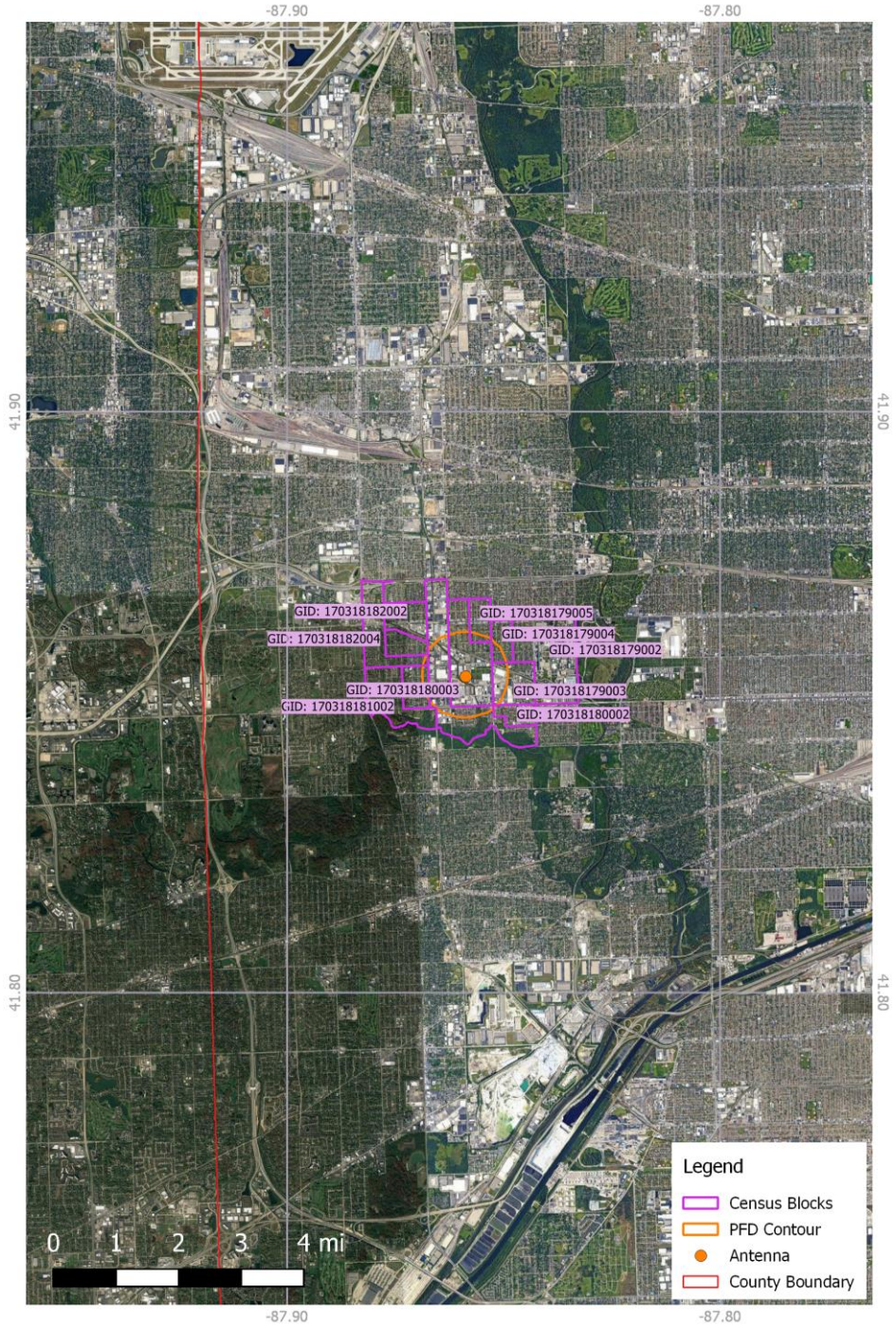
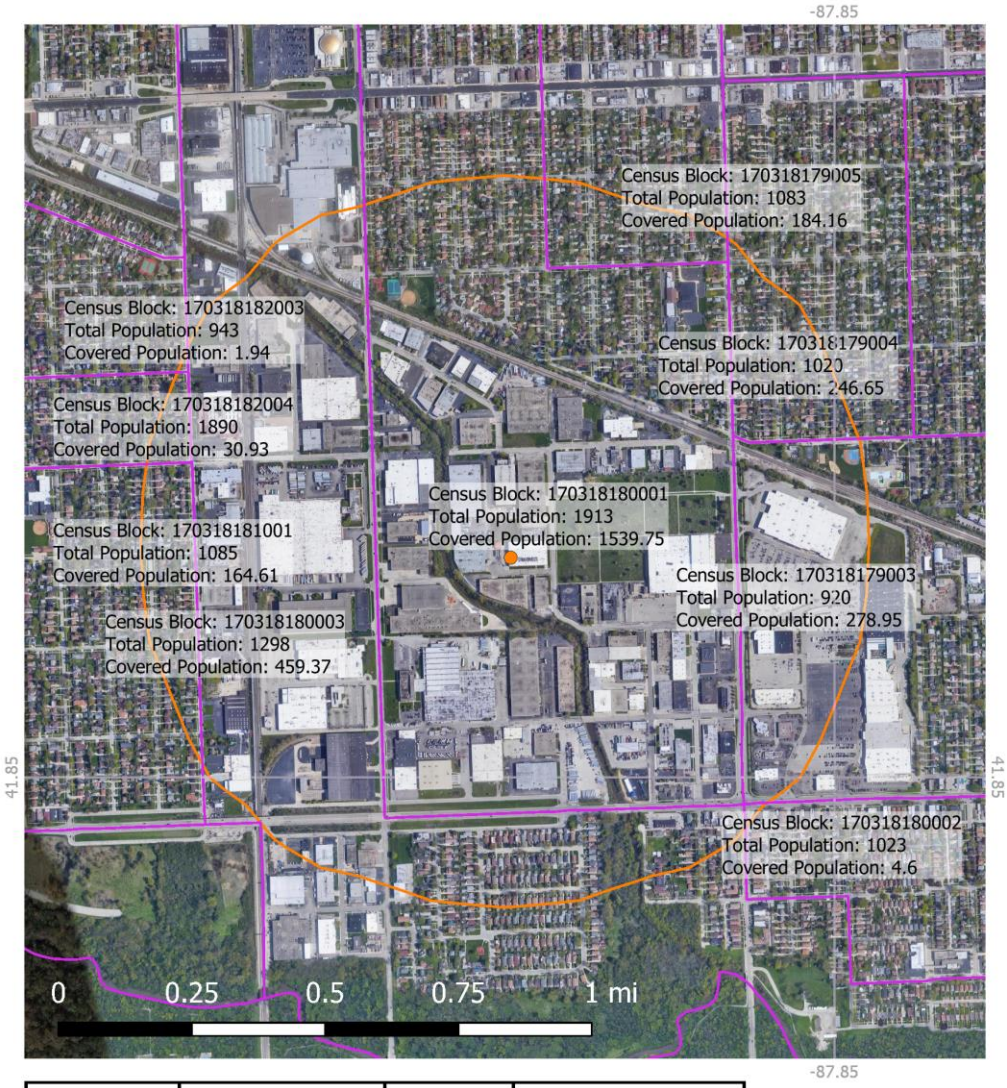


Figure 5b: PFD Contour with distance/mileage scale for Broadview, IL (Callsign E210051)



Census Block ID	Total Block Population	Covered Area	Covered Block Population
170318181001	1085	15.17%	164.61
170318179004	1020	24.18%	246.65
170318182004	1890	1.64%	30.93
170318179003	920	30.32%	278.95
170318182003	943	0.21%	1.94
170318179005	1083	17.00%	184.16
170318180002	1023	0.45%	4.60
170318180001	1913	80.49%	1,539.75
170318180003	1298	35.39%	459.37

Legend

- Census Blocks
- PFD Contour
- Antenna

Total Covered Population = 2,910.96

Figure 5c: PFD Contour with distance/mileage scale for Broadview, IL (Callsign E210051)

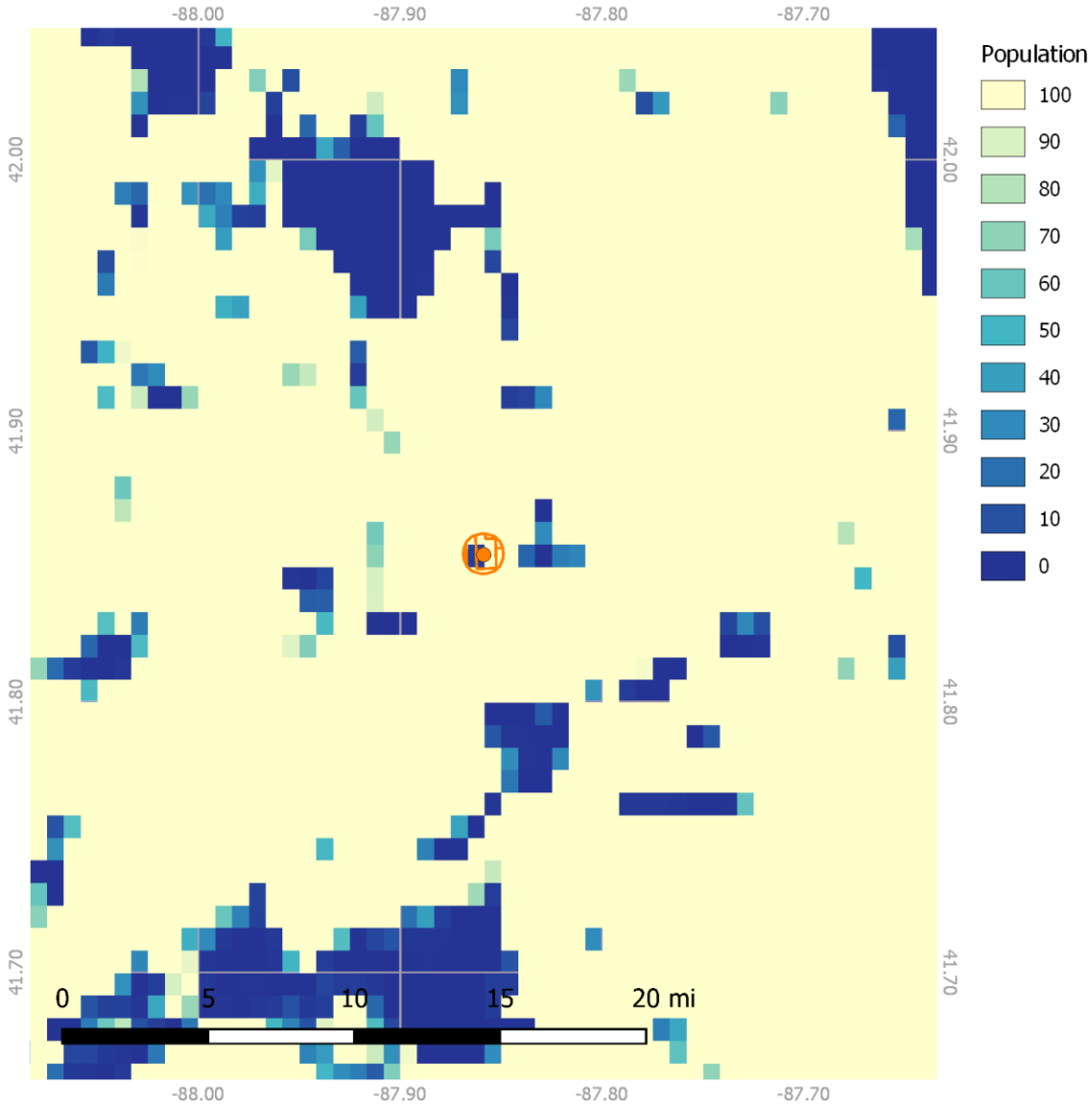


Figure 6: A measured antenna pattern is shown below for relevant off-axis angles that intersect the horizon. The maximum observed sidelobe level is -8.37 dBi. This measurement was completed by an independent third party (NSI-MI Technologies) at the NSI-MI Compact Antenna Test Range at the NSI-MI Technologies facilities in Atlanta, GA. All measurement equipment was also manufactured by NSI-MI to ensure accuracy and precision. The test report can be made available upon request.

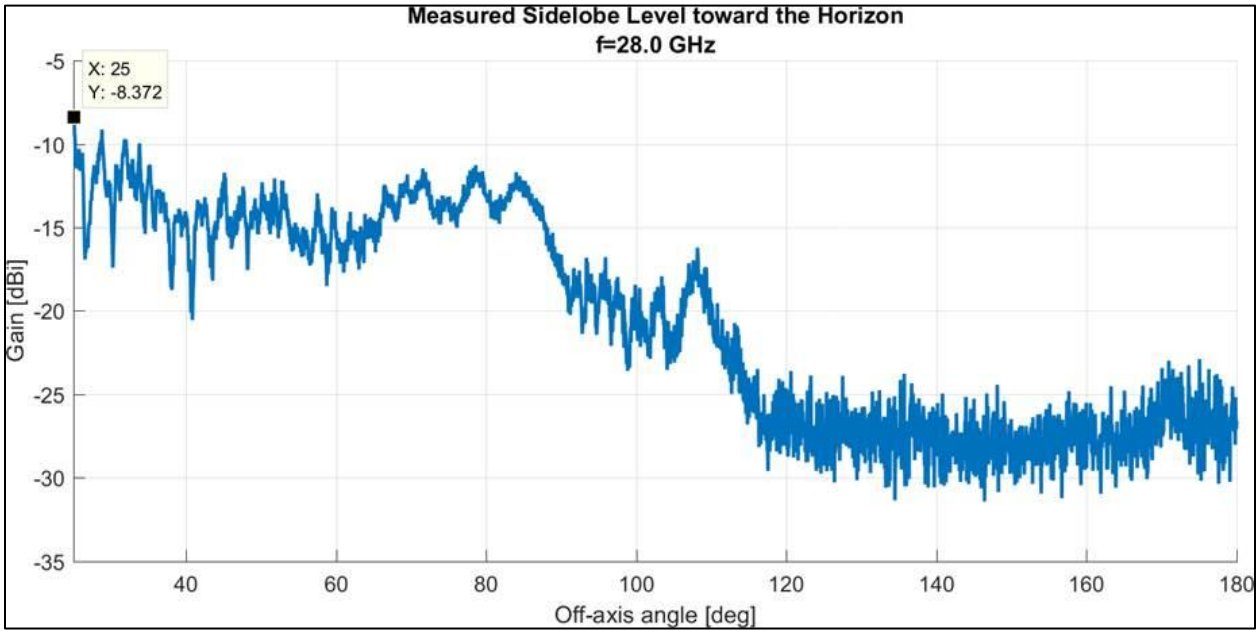


Figure 7a: Google Earth view for Lockport, NY (Callsign E210002). Note that the distances from the earth station to surrounding vegetation and from the earth station to surrounding houses is aligned with, or more conservative than, the 400m clutter assumption being used for PFD contour analysis. In the figure below, the tree line to the south is less than 300 meters away, and the tree line and houses to north are less than 50 meters away. The in-person survey (Figures 7b, 7c) was used to confirm these distances.

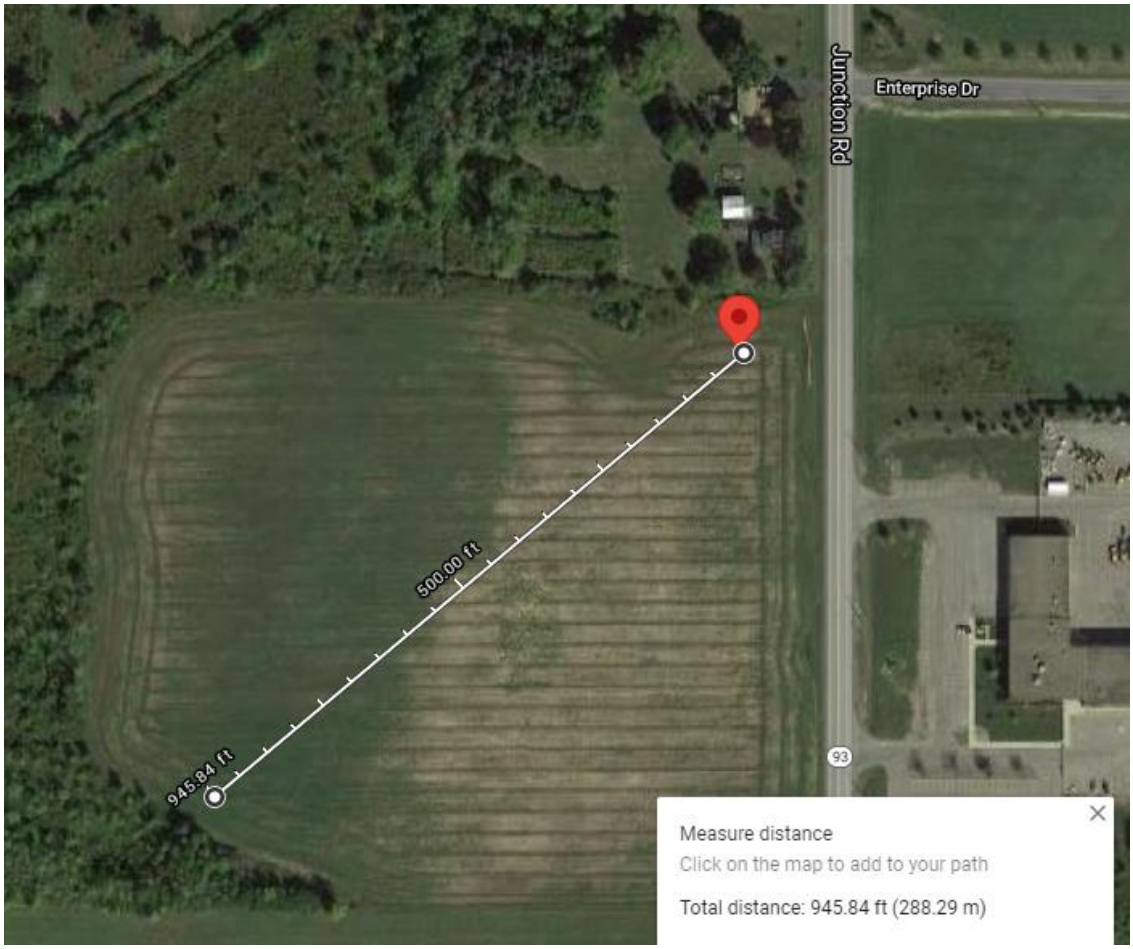


Figure 7b: Photo of surroundings at earth station location in Lockport, NY (Callsign E210002), obtained during in-person site survey. Image includes surrounding trees and houses located North and Northwest of the earth station location. The houses and trees were both found to be less than 50-100 meters away from the gateway location, and greater than 4 meters in height. This is aligned with (and more conservative than) the ITU P.452 clutter assumptions of 400 meters distance and 4 meters height, corresponding with the clutter categories of "irregularly spaced sparse trees" and "sparse houses."

Figure 7c: Photo of surroundings at earth station location in Lockport, NY (Callsign E210002), obtained during in-person site survey. Image includes surrounding trees and houses located North and South of the earth station location. The houses were found to be less than 50-100 meters away from the earth station location, and the trees south of the earth station were found to be less than 300 meters away from anticipated earth station location. The houses and trees were both found to be greater than 4 meters in height. This is aligned with (and more conservative than) the ITU P.452 clutter assumptions of 400 meters distance and 4 meters height, corresponding with the clutter categories of "irregularly spaced sparse trees" and "sparse houses."

Figure 8: Photo of surroundings at earth station location in Marcell, MN (Callsign E202202), obtained during in-person site survey. These images indicate that clutter assumptions used (4 meters height and 0.4 kilometers distance) are conservative. Based on the photos (and measurements taken during in-person survey) tree heights exceed 4 meters in height and are less than 0.4 kilometers from the gateway location.

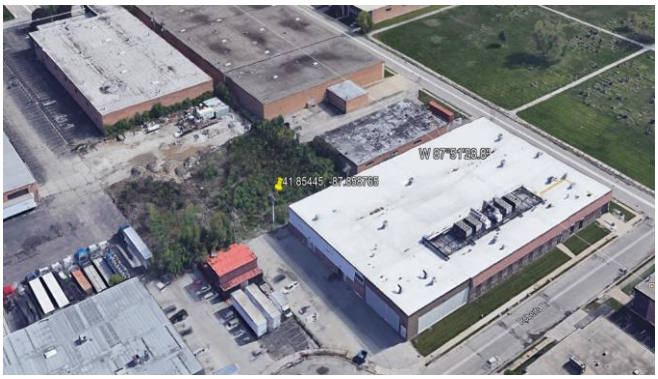
Figure 9: Photo of surroundings at earth station location in Hamshire, TX (Callsign E202201), obtained during in-person site survey. These images indicate that clutter assumptions used (4 meters height and 0.4 kilometers distance) are conservative. Based on the photos and measurements taken during in-person survey, tree and building heights exceed 4 meters in height and are less than 0.4 kilometers from the gateway location.

Figure 10a: Google Earth views and layout drawing for Broadview, IL (Callsign E210051). Approximations of the distances of surrounding buildings from the earth station are listed in the table below, and were confirmed during in-person survey. Note that the distances from the earth station to surrounding buildings are aligned with the "Suburban" clutter category assumptions being used for PFD contour analysis (25 meters distance). A visual evaluation also suggests that building heights are aligned with clutter height assumptions; this was confirmed during in-person survey and discussion with building owners as well.

Approximate Distances of Buildings Surrounding Gateway

Based on Google Earth and in-person survey

Building Location (in Relation to Earth Station)	Distance from Earth Station (meters)
South	10
East	20
Northeast	50
North	70
Northwest	75
West	100
Southwest	25



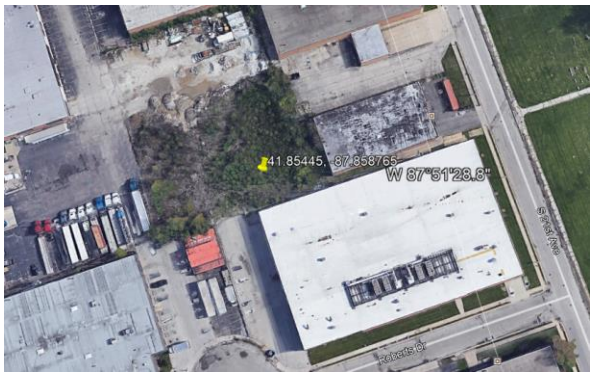


Figure 10b: Photo of surroundings at earth station location in Broadview, IL (Callsign E210051), obtained during in-person site survey. Images were taken from the rooftop of a building approximately 10 meters south of gateway location. During in-person survey, the approximate building distances and heights listed in preceding figure caption and related table were confirmed to be accurate. These images also indicate that building heights are aligned with the clutter assumption being used as part of the "Suburban" clutter category.